THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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THE TELEPHONE COMPANIES.

THE recent Extraordinary General Meetings of the Telephone Company and the Edison Telephone Company, called for the purpose of considering whether an amalgamation of the two enterprises should be effected, must have been watched with considerable interest by the commercial public. The question involved, affects, to a considerable extent, the conveniences which the telephone exchange systems offer. Looking to the wonderful success which the telephonic system has had in America, it is but natural that efforts should be made by those who have plenty of capital at their command in this country to embark the same in enterprises connected with the new branch of telegraphy, and which seem to offer a good prospect of returning handsome dividends.

The long commercial depression which has so seriously affected the prosperity of the country can hardly yet be said to have shown certain signs of passing away, and inasmuch as it has, more or less, affected every branch of trade, the present time is inopportune for judging of the chances of future success which may attend the telephone companies. That every effort is being made to give the systems as wide a scope as possible must be evident to every one, as the network of wires which stretches all over the metropolis, is daily, we might say hourly, growing larger in extent and more offensive, not to say alarming, to the sight. This huge cobweb owes its origin almost entirely to the busy spiders of the telephone companies. Considering the outcry which has been more than once raised against the use of aerial wires, not only on account of their unsightliness, but also on account of the accidents to which they expose the traffic of the streets, it is somewhat surprising that more has not been said on the subject. The Post Office are slowly but surely removing these overhead wires and substituting underground work, but the telephone companies are very quickly making up for this change in the right direction, by putting up ten wires for every one removed by the Post Office. Whether they will be allowed to go on unchecked is, we think, hardly a doubtful question; but the British public has not yet fairly woke up to protest against the disfigurement of our streets. Perhaps when a few more accidents happen they will do so. In the mean time there is a grand opening for an enterprising man to devise a cheap and efficient system of underground wires—perhaps Mr. Brooks will move in the matter; but the difficulties of inductive interference have yet to be overcome.

It can hardly be doubted that the telephone will play a very important part in commercial transactions, and the extent to which it will be used, will, of course, depend in a great measure upon the cheapness with which the power of intercommunication between offices can be afforded. The existence of two or more telegraph companies, each of which undertook, either individually or jointly, to convey a message to any particular locality, involved no greater trouble or expense to the sender of a message than would have been the case if all the work had been carried on by a single company; indeed, the fact of the companies being rivals, as regards the means of communication between large towns, acted as a healthy stimulus, and was advantageous to the public, for each company knew that if there were any delay in getting off the message work, that work would be put into the hands of their more expeditious rival.

In the case of the telephone exchange systems, the conditions are different. The element of delay is altogether absent; one renter can communicate with another immediately, or he must wait till the other is disengaged: there is no intermediate course. The fact, however, of one company having its exchange in communication with one set of renters, and the second company with another, is quite a different affair. It means that the two sets are cut off from communication with each other unless a double rental is paid by each renter. This, it is needless to say, would not be approved of, and the very fact of the difficulty existing would deter many commercial men from subscribing to either company. If the two companies amalgamated, the objection would cease to exist, and very many persons who now hold back would be certain to become subscribers, to the great advantage of the shareholders.

The determination to unite the two companies referred to having been carried unanimously at the two meetings, those interested in the success of the telephone exchange system have great cause for congratulation.

IT will gratify electricians to know that Professor David Edward Hughes has been elected a Fellow of the Royal Society.

ON SOME THERMAL EFFECTS OF ELECTRIC CURRENTS.*

By WILLIAM HENRY PREECE, General Post Office.

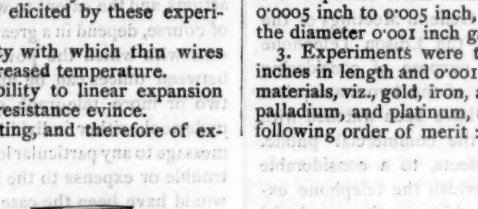
I HAVE been engaged for some time past in experimenting on the thermal effects of electric currents, but the final results of those experiments are not sufficiently ripe at present to justify my bringing them before the Royal Society. I have, however, obtained one result which I believe to be sufficiently novel to justify a short preliminary note.

The most striking facts elicited by these experiments are :—

1. The extreme rapidity with which thin wires acquire and lose their increased temperature.

2. The excessive sensibility to linear expansion which fine wires of high resistance evince.

Now as the rate of heating, and therefore of expansion and contraction, varies very nearly directly as the increment or decrement of the currents, when these variations are very small, it occurred to me that if a long wire of small diameter and high resistance were attached to a sounding board, or to the centre of a disc (such as one of those used for telephones and phonographs) and it formed part of a circuit conveying telephonic currents, sonorous vibrations ought to be reproduced.



The sketch shows the arrangement of the apparatus used for the experiment.

It consists of a stout base of mahogany, on which a brass support was attached so that it could slide and be fixed at any distance from the upright at the further end of the base board.

A disc of thin paper, and then of thin iron, was mounted on the upright.

The wire experimented upon had its ends connected to terminals on the wooden base, so that it could be inserted in a circuit consisting of a microphone transmitter, T, and a battery of six bichromate of potash cells in another room out of hearing.

A platinum wire of 0·003 inch diameter and six inches long from end to end was first used, and the sonorous effects were most marked and encouraging, when the microphone transmitter, T, was spoken into. The articulation, though muffled, was clear, and words could easily be heard.

1. Experiments were first made to determine the length which gave the loudest sound and the clearest articulation, and, after repeated trials with every variation of length from one inch to six feet, it was found that a wire six inches long gave the maximum effect.

2. Experiments were then made to determine the diameter of the wire that gave the best effect, and after repeated trials with every gauge drawn from 0·0005 inch to 0·005 inch, it was found that wire of the diameter 0·001 inch gave the best effect.

3. Experiments were then tried with wires six inches in length and 0·001 inch diameter of different materials, viz., gold, iron, aluminium, silver, copper, palladium, and platinum, and they came out in the following order of merit :—

Platinum	Very clear.
Aluminium	Very variable.
Palladium	Clear.
Iron	Clear.
Copper	Faint.
Silver	Faint.
Gold	Very poor.

4. The effect of mechanical strain was tried. It was found not to vary the effect. When once the requisite tension, which varied with each metal, was obtained, further tightening up did not vary the clearness or loudness of articulation.

Gold would scarcely bear the tension required to reproduce sonorous vibrations, hence its low position.

5. Very thin carbon pencil, ·0625 inch diameter, was tried under compression and under tension, but no effect whatever was experienced unless a bad joint was made, when at once a faint microphonic effect was apparent.

6. No sibilant sounds whatever could be reproduced.

7. That the effect was due to heating and cooling, was shown by the fact that it was possible to increase the current to such a strength as to render the temperature of the wire sensible to the touch,

* Read before the Royal Society, May 27th, 1880.

and then to make its elongation and contraction by low sounds evident to the eye.

It therefore appears from these experiments, that wires conveying those currents of electricity which are required for telephonic purposes expand and contract as they are heated and cooled, and as the variations in the strength of the current are small compared with the strength of the current itself, the expansion and contraction vary in the same ratio as the condensation and rarefaction of the air particles conveying the sonorous vibrations which produced these vibrations.

The mechanical changes, or molecular vibrations in the wire, due directly or indirectly to telephonic currents, which result in the reproduction of sound, bear a close analogy to the mechanical changes due to the direct transmission of sound, but with this important difference, that while the vibrations due to sound are progressive along the wire, and their velocity is low and easily measured, those due to thermal effects are practically instantaneous, and therefore affect simultaneously the whole length of the wire.

Note.—De la Rive, in 1843 (*vide* "Electricity," vol. i., p. 304), observed that an iron wire emitted sounds when rapid discontinuous currents were passed through it, but he attributed the effect to magnetism, for he failed to obtain the same effect in non-magnetic wires like platinum or silver.

Graham Bell found, in 1874, that a simple helix without an iron core emitted sounds, and (in 1876) that very distinct sounds proceed from straight pieces of iron, steel, retort carbon, and plumbago when conveying currents.

Professor Hughes showed that his microphone was reversible, that is, that it could receive as well as transmit sonorous vibrations.

Mr. Weisendanger (*Telegraphic Journal*, Oct. 1, 1878) reproduced sounds on a microphonic receiver, which he called a thermophone, and attributed the effect to its true cause, viz., the expansion of bodies under the influence of heat, which, in fact, is the explanation of all microphone receivers.

Ader reproduced speech by the vibrations of a wire conveying currents of electricity, but he found that only magnetic metals were effective, and therefore, like De la Rive, he attributed the result to magnetic agencies. (*Vide* Count du Moncel, *Telegraphic Journal*, March 1, 1879.)

These and many other sonorous effects of currents on wires may be really due to such heat effects as I have described.

W. R. SYKES' DOUBLE ARM BLOCK INSTRUMENT.

AS USED ON THE MAIN LINE OF THE LONDON, CHATHAM AND DOVER RAILWAY.

FIG. 4 is a front view of a complete instrument for working both the up and down traffic, and is fixed at each end of a section. A (fig. 4) is a dial fitted with two arms, B and B.I., mounted behind a post, C; the arm, B.I., on the right hand side of C is worked by an insulated rod, D (figs. 1, 2, 3), connected to the reversing axle, E (figs. 1, 2, 3), the end of which passes to the outside of the case, and by means of knob F (figs. 1, 3, 4), can be turned to the right or left. On the other end of reversing axle, E, is fitted a cam, G (fig. 2), which works between two springs, H, H.I. (figs. 1, 2, 3).

The double stud, I, I.I. (figs. 1, 2, 3), is fixed between the springs, H, H.I., on the back of case, and on turning the knob, F, say to the right, the reversing axle, E, with the cam, G, turns also, cam G taking spring H.I. away from the pin of stud I, and allowing spring H to make contact with the pin of stud I. Cam G also makes contact with H.I.

Spring H is connected to the zinc of the battery; spring H.I. to the copper of the battery.

The turning of knob F, in addition to reversing the battery connections, also (by means of rod D) moves the arm, B.I., to a horizontal or "danger" position. By depressing the key or tapper, K (figs. 1, 2, 3, 4), which is connected to terminal 4 or Line, the latter, by means of the contact block, M (figs. 1, 2), is connected to reversing axle E and cam G, and thence to spring H.I. By the depression of the key also, the insulated back portion, *k*, of the key or tapper, K, raises a spring, N, which, together with terminal 6, is connected to terminal 1 or Earth, into contact with stud I, 1 (stud 1 being in contact with spring H), thereby sending the Copper current to Line and the Zinc to Earth.

By turning the knob F to the left, the arm, B.I., is lowered to "Clear," and the key being again depressed, the current is reversed, Zinc going to Line, and Copper to Earth.

The foregoing describes the arrangement for sending reverse currents, which is all mechanical. We will next consider the working of arm B, which is controlled by the instrument in the next section. Arm B is mounted on an axle having behind the dial a steel arm, O (fig. 2), kept magnetised by magnet P (figs. 1, 2, 3), working between two shoes, *n*, *s*, of the electro-magnet, Q (figs. 1, 2, 3). In giving "train on," by depressing key K, without moving knob F, arm B being at "clear," a current is sent to the electro-magnet of the instrument in the next section, which rings the bell there by attracting armature R (fig. 3), but does not alter position of arm B of that instrument. If the train is accepted, the knob, F (of instrument in next section), will be turned to the right, putting arm up to "danger," and the key depressed sending a current to line (which enters *vid* 4, K, M.I. (fig. 2), to terminal 5 (fig. 2) into electro-magnet Q; from thence it passes through terminal 6 (fig. 2) to earth. This causes arm O to be moved from *n* to *s* (fig. 2), raising arm B to "danger."

When a "clear" signal is given, knob F will be turned to the left and arm lowered to "clear," the key depressed, and a reverse current sent into electro-magnet Q, which will bring arm B to "clear." It will be seen that the current passes direct from the battery without going through any coils or electro-magnets to line, thus saving a great portion of the ordinary gear put into block instruments.

In whatever position the arm of one instrument stands—Up or Down, Clear or Blocked—so the current is sent, putting the corresponding arm at the other end of the same position.

Fig. 1.

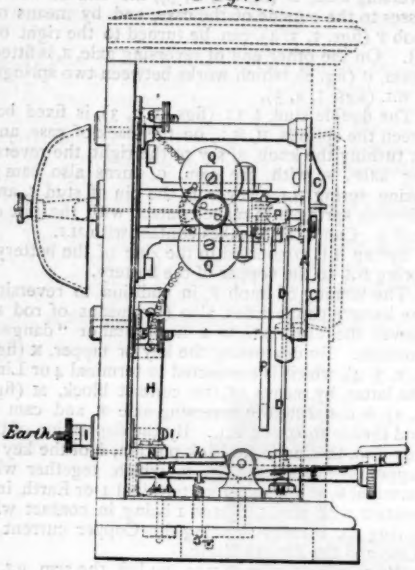


Fig. 2.

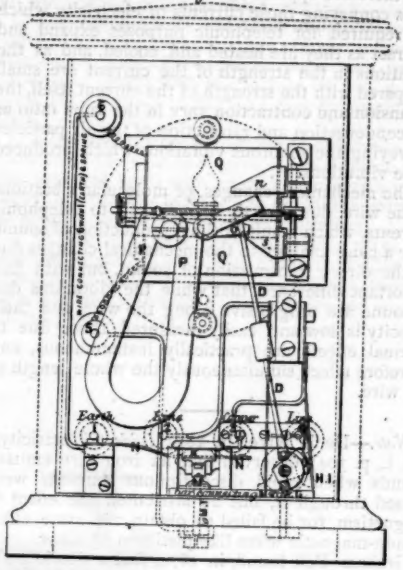


Fig. 3.

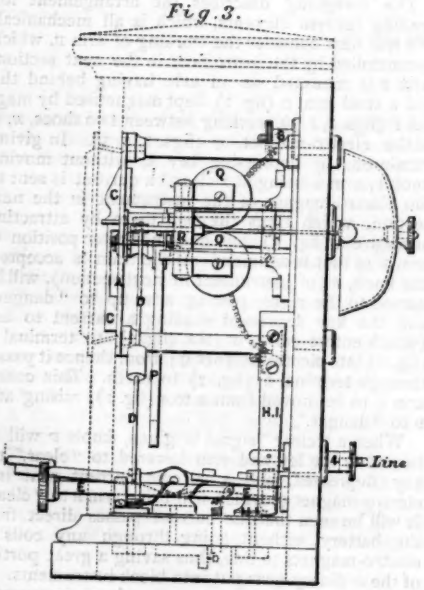
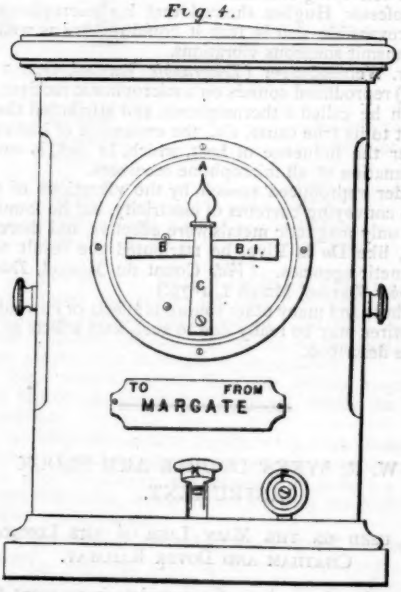


Fig. 4.



These instruments have been made partly from the old tapper bells by "Izant," and make a good and cheap block instrument with only *one* wire. The cost of each instrument is about £5 10s., and the old tapper bells can be altered at much less cost.

HUNNING'S MICRO-TELEPHONE TRANSMITTER.*

IN its crude form the Hunning's Patent Micro-telephone Transmitter was in existence about three years ago, and has subsequently passed through a long series of modifications. Its present and most approved form was designed for the patentee by Mr. Cox-Walker, of York, to embody the various improvements suggested by experience. Its outward appearance is similar to that of the ordinary Bell telephone, but the resemblance stops there. The usual mouthpiece is covered on the under side of the opening by a piece of nickel-plated brass wire gauze, which forms a protection to a thin sheet of platinum foil. This foil acts the part of a vibrating diaphragm, and is in immediate contact with a very thin layer of granulated coke, which fills a small cavity provided with a brass plate at the bottom. The platinum foil is connected to one terminal through the brass ring, and the brass plate is connected to the other terminal. The terminal wires are then passed through the hole down the centre of the handle; the latter is screwed on to the central part, and the instrument is complete. In connecting it up for use, a receiving telephone (which may be Bell's or other similar instrument) is required at each end of the line in addition to the micro-telephone transmitter, and also a battery of Leclanché or other cells. The function of the transmitter is, by the aid of the battery current, so to increase the sound given out by the receiving telephone as to make these instruments a practical success, and also to overcome by its power the effects of induction from neighbouring wires, this latter having hitherto prevented the use of telephones on wires in the neighbourhood of others along which strong voltaic currents may be passing. The success of Hunning's Micro-telephone in this respect has been undoubted, and its clear articulation and power surprise all who hear it. The loose granulated coke between the two metallic plates is the secret of this success. When the platinum foil is spoken through at the mouthpiece, the aerial waves cause more or less of its under surface to come into contact with the grains of coke, at the same time causing these particles to press more closely upon each other, thus decreasing the amount of the resistance they offer to the passage of the voltaic current through them by bringing more points into contact with each other, this action taking place in a greater or less degree in accord with the amplitude of the vibrations of the platinum foil acting under the influence of the sonorous waves. The control which this movement of foil and coke grains exercises over the passing current is most perfect and wonderful, and it renders the use of an induction coil, which is found to be so great a necessity with all other forms of telephone transmitters—Edison's, Crossley's, and Blake's, to wit—quite unnecessary; and by the use of a special form of receiver, which is now engaging the attention of Messrs. Hunning and Cox-Walker, the effects of induction are hoped to be entirely eliminated, the experiments hitherto made by them in this direction giving promise of ultimate success. An automatic switch board, with call bell and ringing key, completes the outfit for each end of a line for telephonic purposes. The instruments were successfully tried a few weeks ago between York and Darlington, a distance of about 45 miles, the wire used for the purpose of this test trial being one of about 20 of the ordinary telegraph wires which stretch from pole to pole along the side of the railway. The effects of induction were at times most powerful, but they did not prevent the easy and successful carrying on of conversation or the transmission of ordinary railway cypher messages between the two stations.

* Abstract of Proceedings of the Cleveland Institution of Engineers.

VARLEY'S ELECTRIC TIME BALL.

THERE are few Londoners who do not recollect the time ball which formed such a prominent object on the top of the domed-shaped roof of the West Strand Telegraph Office. The apparatus, though an object of curiosity to our country cousins, and eagerly watched by an admiring crowd as the hour of 1 approached, ceased to exist after the transfer of the telegraphs of the United Kingdom into the hands of the State. Its removal, though no doubt lamented by some, has not been a great loss, as it can hardly be said to have been required in the locality where it was placed. Messrs. Dent, the well-known watch and clock makers, however, some time ago, made up for the removal by placing a time ball on the roof of their establishment in Trafalgar Square, which forms a conspicuous, if not handsome, object in that locality.

Several time balls are at present in use in our seaport towns, and prove of great value to the vessels which desire to set their chronometers to time. Mr. S. A. Varley has recently completed orders for time balls for India, and the apparatus invented by him is of the most improved pattern, and is thoroughly well designed for the purpose.

The design of a time ball apparatus at first sight may seem a very simple matter; a ball held at the top of a mast by a trigger, which trigger is released by an electro-magnet, when a time current is sent, would seem to be all that is required. The mechanism by which the object in view is to be accomplished is, however, by no means so simple as might be imagined. The weight of a ball six feet in diameter is not inconsiderable, and this dead weight of several hundredweights pressing on the trigger renders the latter very difficult of withdrawal, indeed, it cannot be released by the direct action of an electro-magnet. The apparatus, also, being usually set out of sight of the clock mechanism which releases it, requires to indicate whether it has acted correctly when the time current is sent out.

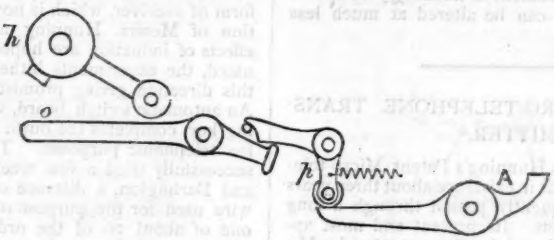


FIG. 1.

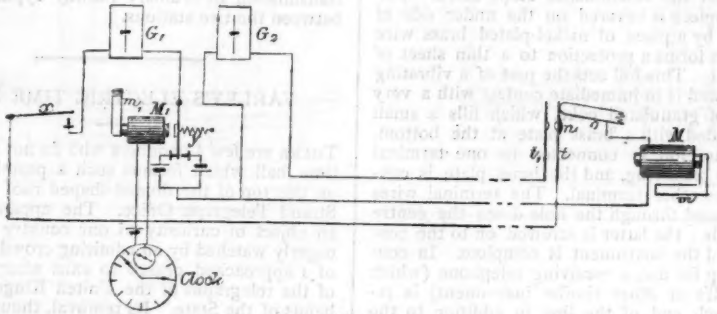


FIG. 2.

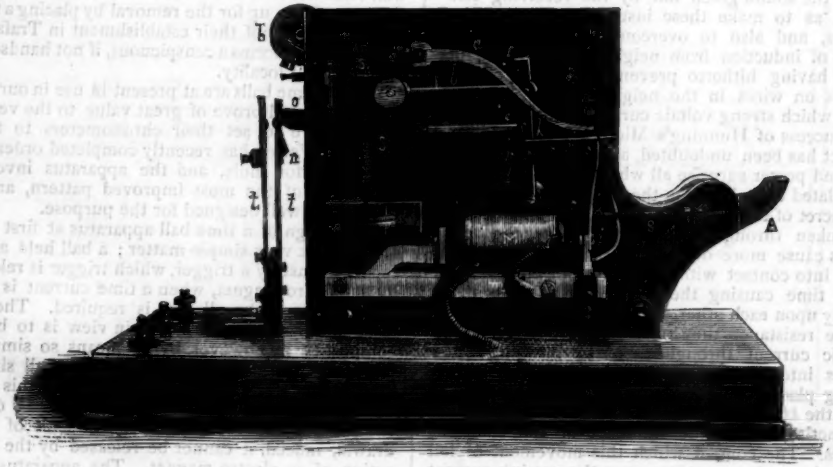


FIG. 3.

The apparatus which has recently been despatched to India by Mr. Varley consists of a hollow ball of zinc nearly six feet in diameter, this is attached to a piston rod with rack teeth cut in it, by means of which the ball can be raised with a winch to the top of the mast on which it slides. The piston at the end of the rod moves easily in a cylinder, and can drive out the air freely in front of it until it has fallen to within about a foot of its resting position, when it encounters the resistance of the cushion of air below it, which latter can only escape by a valve heavily weighted; when the ball is released, therefore, it falls quickly for the greater portion of its drop, and then gently for the last few inches, thus it is brought to rest without a jar or shock.

The trigger mechanism is shown by figs. 3 and 1, the latter indicating the parts hidden by the frame of the apparatus seen in fig. 3.

A is a strong lever with a hard steel face at A, upon which a projection from the piston rod rests, when the latter is in its highest position. This lever is of very strong make, with a stout steel axle, as it has to bear the full dead weight of the ball and piston rod. *p* is a second lever, bent, and with a steel friction wheel against which the longer end of the lever, A, rests; with *p* in the position shown, no amount of downward pressure on the curved end of A can cause the latter to fall. *o* is a third lever, by the depression of which *p* is moved, and the friction wheel slid off the lever, A. Finally, *h* is a hammer, which, on being released, strikes a heavy blow on *o*, which latter then actuates *p*, and by sliding off the friction wheel, allows the curved end of A to fall under the pressure of the piston rod and ball, and thus allow the latter to drop.

Referring now to fig. 3, *b* is a lever fixed to the same axis as the hammer, *h*; the weight of this lever is balanced and a pull given to the hammer to quicken the action of the latter, by means of the spring, s_1.

The vertical lever, *d*, has a piece, *f*, screwed to it, against the lower part of which a pin, screwed to the inner side of *b*, normally banks, thus preventing *b* from rising and *h* from falling.

a is a curved lever which is linked to *d*, so that when *a* falls, it pulls *d* to the right. The end of this lever has a small friction wheel.

g is a vertical lever, to which is fixed an armature, which is normally pulled by the core of the electro-magnet, M, this core being magnetised by the permanent steel magnet, *m*. On the top end of *g* the friction wheel at the end of *a* normally rests.

The action of the apparatus is then as follows:—Supposing the lever, *g*, to be drawn to the left, then the end of lever, *a*, is released, and it consequently drops under the action of the spring, s_2, *d* is then drawn to the right, and the pin on the end of *b* escapes from the piece, *f*, and thus *b* is released and *h* allowed to fall, when the actions on the pieces shown in fig. 3 occur in the manner previously described.

In setting the apparatus again, the hammer, *h*, is lifted up, this depresses the lever, *b*, and the pin of the latter pressing against the inclined side of the piece, *f*, pushes the lever, *d*, to the right; when the pin has cleared *f*, it then comes against the inclined piece, *c*, which is also screwed against *d*, this causes *b* to be moved to the left, and thus to lift the curved lever *a* so that the friction wheel at the end of the latter is raised until it again banks down upon the top of the armature lever, *g*.

The pieces seen in fig. 1 come back to their normal position when the hammer, *h*, is raised by the weight of the arm of A; thus the weight of the arm of A presses aside by its curved underside the arm of the lever, *p*, which has the friction wheel upon it, and then, on passing beyond it, allows the lever to drop to the position shown in the figure.

By means of the piece, *k*, which is moved by the pin, *r*, on the lever, *d*, the armature lever, *g*, is pushed over towards the electro-magnet cores when the hammer, *h*, is raised a little beyond its normal position.

The electrical arrangement by means of which the lever, *g* (fig. 3), is actuated, is shown in general principle by fig. 2.

M_1 is an electro-magnet whose cores are magnetised by a permanent magnet, m_1; the armature of this electro-magnet is normally pulled by the spring, *y*, away from the cores, but its tensile strength is not sufficient to overcome the magnetic pull unless the latter is decreased by a current sent by means of the clock.

The lever of the armature plays between two contacts connected to a "split" battery. *x* is a lever which is depressed when a handle is turned to "Time circuit closed," this handle, when turned half round towards this last position, pulls the armature of M over to the magnet cores, and then, on being turned the other half, leaves the same free, but the armature does not drop back again, as it remains attracted to the cores by the permanent magnetism of *m*.

The spring, *t* (fig. 3), is in contact, when the apparatus is set, with the end of lever, *o*, which latter is connected to one end of the wire of electro-magnet M through the frame of the instrument.

Supposing the ball to be wound up to the top of the mast, and held there by trigger A (figs. 1 and 3), then, a few minutes before the time current is given by the clock, the handle of the apparatus (fig. 2) is turned to "Time circuit closed," this depresses *x* against its stop, and moves the armature of M_1 against the cores of the latter, where it remains, held under the influence of the permanent magnet, *m*; a current from the left-hand battery consequently circulates through galvanometer, G_1, through the lever, *x*, and along the lower circuit to spring, *t*, and thence through the electro-magnet, M, back to the battery. By this current the needle of b_1 is deflected to "Time circuit closed," and the magnetism of M is *in*creased, so that the lever, *g*, is held more firmly on the locking position.

As soon as the exact hour arrives, the clock sends a current through M_1, decreasing the permanent magnetism in its cores, and releasing the armature, which consequently moves over to the right-hand stop under the influence of the spring, *y*. A reversal current is consequently sent by the right-hand battery, which deflects the needle of b_1, in the reverse direction, to "Current sent out;" this reversal current *de*creases the magnetism of M, and allows the lever, *g*, to be pulled to the left by the antagonistic spring, and to release the levers, and thus discharge the ball.

Now, immediately on the fall of the hammer, *h*,

the lever, *o*, being depressed, comes in contact with the ebonite projection, *n*, of the spring, *t*, and thus the current through M is cut off; but, at the same time, the spring, *t*, becomes pressed against the spring, *t*, and the current now flows through the galvanometer, G_2, deflecting it to "Ball discharged," thus indicating that the mechanism has acted properly. When this is seen to have taken place, the handle, before referred to, is turned to "Time circuit open," so as to cut the battery off, and it is left in this position until the time again arrives for the ball to be wound up.

The three wires shown in fig. 2 are only required between the time ball and the relay apparatus, in fact, are only local wires; the magnet, M_1, which sets off the mechanism, and which is worked by the observatory clock, of course only requires the usual single wire.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XI.

DIRECT WRITER DUPLEX SYSTEM—(*continued*).

IT has been generally understood and explained that the principle of the Duplex telegraph system involves the production of an exact balance on the receiving portion of the transmitting instrument, so that when the key of the latter is worked no effect is produced; this is only partially true, that is to say, a balance, but not an exact balance, has to be obtained. To obtain an exact balance is impossible, as can be seen by reference to fig. 50, which represents the general principle of the Duplex system as worked by the Post Office. Referring to this figure, let us suppose the key at the "Up" station to be depressed, then in order that no effect may be produced on the electro-magnet, M_1, at that station, it would be necessary that the resistance, R_1, be equal to:—the resistance of the line, plus the balancing resistance, R_2, at the distant station (which resistance will be equal to R_1), plus the resistance of the two coils of the magnet, M_2. It is obviously impossible that this can be the case, consequently exact equilibrium can never be produced.

In what way then do the balancing resistances enable duplex working to be effected?

Now, although the balancing resistances cannot enable a neutral effect to be produced on the electro-magnet at any one station when the key at the latter is worked, still it can enable a comparatively small effect to be produced on the same, an effect due to the difference in the strengths of the currents passing respectively in opposite directions through the two coils of the electro-magnet, and which can be counteracted by the tension of the armature spring.

But, it may be asked, what values should the balancing resistances have? The answer to this is—the adjustment must be such, that when signals are sent from the distant station, the strengths of these signals must not be altered, on alternately depressing and raising the key at the home station. The values of the balancing resistances necessary to produce this result are of course found by trial, their theoretical value it is unnecessary to determine.

Supposing the required balance to be obtained, then the action of the apparatus will be as follows:—Supposing the key, K_1, at the "Up" station to be depressed, the one, K_2, at the "Down" station being in its normal position, then the current from the battery, E_1, will split, half going through the resistance, R_1, and the coil of M_1, represented by the . . . . . line; the other half will go out to Line to the "Down" station and through the balancing resistance, R_2, from thence it will pass through the . . . . . coil of M_2 and back through the coil represented by the ——— line, to Earth, from there it will pass back to the Earth at the "Up" station, and through the ——— coil back to the battery. It will be noticed that the current passing through the two coils at the "Down" station does so in opposite directions, and as the coils are wound in *opposite* directions the full magnetic effect due to the two is produced, consequently the instrument responds. The currents passing through the coils at the "Up" station do so in the *same* directions, consequently a small magnetic effect only is produced, due to the two currents being of unequal strength. This small effect, as was explained, is counteracted by the tension of the armature spring.

If the "Down" station depresses his key whilst the "Up" station key is left in its normal position, then the instrument at the "Up" station of course responds.

Lastly, supposing both keys to be depressed, then since the two batteries have their opposite poles in connection with one another through the line, and through the ——— coils of the electro-magnets at the two stations, these batteries will send a strong current through the coils; also each battery will send a current through the balancing resistances and through the . . . . . coils, but the strength of the currents going through the ——— coils will be about double that going through the . . . . . coils, consequently both electro-magnets must respond.

In adjusting the balancing resistances or rheostats the telegraphist at, say, the "Up" station sends signals on his key to the "Down" station, and the latter adjusts his rheostat until he finds that his received signals do not alter in strength when he keeps his own key alternately depressed and raised. If there is too much resistance in the rheostat the received signals will be strong when the home key is at rest, and weak when it is depressed. The telegraphist is thus able to judge whether he must increase or decrease the resistance in the rheostat. When it is found that the signals are uniform the received signals are stopped, and the home station works his key, and increases the tension of his armature spring until his own signals cease to affect his apparatus. A similar operation is then gone through by the distant station.

Now, it must be obvious that when the Down station adjusts his rheostat, after the Up station has obtained his required balance, the latter must be thrown out again. This is true to a certain extent, but the amount by which it may throw the balance out is comparatively small. That is to say, for example, one hundred ohms wrong in the home rheostat would affect the home instrument more than would two or three hundred ohms wrong in the distant rheostat. If this were not the case the balancing would give a great deal more trouble than it actually does.

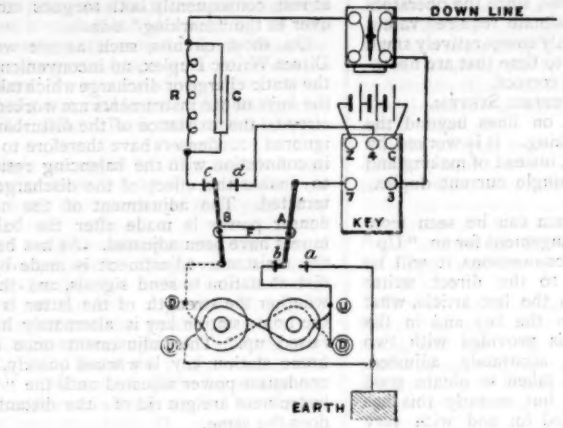


FIG. 51.

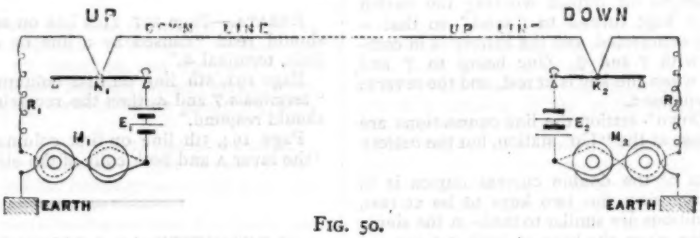


FIG. 50.

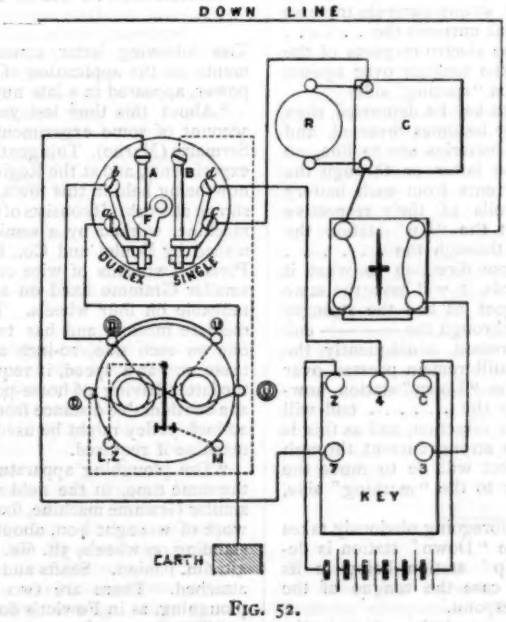


FIG. 52.

Of course at starting, more trouble is caused in the balancing than after a time, since the operators soon get to know the approximate required values of the resistances, and it is only comparatively small variations of these from time to time that are necessary to keep the adjustments correct.

DOUBLE CURRENT DUPLEX SYSTEM.

This system is employed on lines beyond the range of single current working. It is worked by means of relays, and the key, instead of making and breaking contact, as in the single current duplex, sends reversals.

The principle of the system can be seen from fig. 51, and the general arrangement for an "Up" station from fig. 52. The connections, it will be noticed, are very similar to the direct writer duplex indicated by fig. 48 in the last article, what difference there is being in the key and in the galvanometer. The latter is provided with two differentially wound coils accurately adjusted. Formerly no great care was taken to obtain good adjustment in the winding, but recently this has been more carefully attended to, and with very beneficial results.

When arranged for duplex working the switch of the key is kept turned to "send," so that 4 and 3 are disconnected, and the battery is in communication with 7 and 3, Zinc being to 7 and Copper to 3 when the key is at rest, and the reverse when it is depressed.

At the "Down" station the line connections are similar to those at the "Up" station, but the battery is reversed.

The action of the double current duplex is as follows:—Supposing the two keys to be at rest, then the conditions are similar to those in the single current duplex when the keys at both stations are depressed; that is to say, strong currents traverse the ——— coils and weak currents the . . . . . coils; but the effect on the electro-magnets of the relays is such as to press the tongues over against the insulated contact on the "spacing" side.

If now the "Up" station key be depressed, then the current from that key becomes reversed, and as similar poles of the batteries are to line, no current flows through the latter or through the ——— coils, but currents from each battery traverse the . . . . . coils of their respective electro-magnets. Now at the "Up" station the direction of the current through the . . . . . coil will be in the reverse direction to what it was at first; in other words, it will have the same effect on the electro-magnet as had the stronger current that was passing through the ——— coil before the key was depressed, consequently the tongue of the relay will still remain pressed over to the spacing side. At the "Down" station, however, the current through the . . . . . coil will not have been changed in direction, and as this is not now opposed by the strong current through the ——— coil, its effect will be to move the tongue of the relay over to the "marking" side, and to produce a signal.

A similar action to the foregoing obviously takes place when the key at the "Down" station is depressed, that at the "Up" station being in its normal position; in this case the tongue of the "Up" station relay will respond.

When both keys are depressed, the action is the exact reverse of what it was when both keys were at rest, consequently both tongues must be moved over to the "marking" side.

On short circuits, such as are worked by the Direct Writer Duplex, no inconvenience is felt from the static charge or discharge which takes place when the keys of the instruments are worked, but on long circuits the existence of the disturbance cannot be ignored; condensers have therefore to be introduced in connection with the balancing resistances so as to enable the effect of the discharge to be counteracted. The adjustment of the necessary condenser power is made after the balancing resistances have been adjusted. As has been explained, the resistance adjustment is made by causing the distant station to send signals, and then observing whether the strength of the latter is altered when the home station key is alternately held down and raised up. This adjustment once obtained, the home station key is worked quickly, and then the condenser power adjusted until the "kicks" on the instrument are got rid of; the distant station then does the same.

ERRATA.—Page 191, 11th line on second column, should read "caused by a line or an instrument fault, terminal 4."

Page 192, 8th line on first column, should read "terminals 7 and 4, then the receiving instrument should respond."

Page 194, 5th line on first column, should read "the lever A and both coils of the electro-magnet."

ELECTRICITY AS A MOTIVE POWER.

THE following letter, concerning certain experiments on the application of electricity as a motive power, appeared in a late number of the *Times*:—

"About this time last year I sent you a short account of some experiments by Mr. C. Felix, of Sermaize (Marne). This gentleman has continued his experiments, and at the Regional Agricultural Show now being held in this town, his apparatus has been shown at work. It consists of the ordinary 'Gramme' machine, worked by a semi-portable engine, furnished by Boulet and Co., Faubourg Poissonnière, Paris. Two coils of wire convey the power to a smaller Gramme fixed on a framework of wood, movable on four wheels. This acts as an intermediate motion, and has two broad-face pulleys, one on each side, 20-inch and 14-inch diameter; these run at a speed, if required, of 800 a minute, the latter driving a 6 horse-power thrashing machine at a considerable distance from the main power. The 20-inch pulley might be used for driving any other machine if required.

"The ploughing apparatus, which is at work at the same time, in the field adjoining, consists of a similar Gramme machine, fixed in a very solid framework of wrought iron, about 6ft. long by 5ft. wide, standing on wheels, 3ft. 6in. diameter, in front, and 4ft. 6in. behind. Shafts and a locking gear are also attached. There are two of these at work for ploughing, as in Fowler's double tackle.

"The Gramme has two pulleys, as I before stated,

one on each side. These, by friction rollers, work the drum of the ploughing tackle, round which the steel wire rope is coiled, the drum being in the centre of the carriage, the wire escaping from the lower part near the ground, and guided in its course by two flat rollers.

"The plough is one of Howard's double-furrow, supplied by Mr. Pilter, Paris, and fitted for the purpose.

"The power is conveyed in an instant from the main power in the showyard by a coil of wire on wooden reels, long enough to reach several fields off.

"The plough worked clean and regularly about seven or eight inches deep. The ground was very hard and uneven, as this part of France is suffering very much from want of rain. One man is required to each machine, and one man to the plough, three in all. The ploughing was not very straight, for, as the people crowded about the plough and on the ropes, the driver could not see where he was going. Directly the plough reached the end of its course, it was lowered and returned, the machine being thrown out of gear and reversed with the greatest ease.

"The machines are also advanced or retired without the least difficulty. When this is done, the friction rollers are detached, and the power conveyed to a chain and notched wheel, which move the machine rapidly forward as the ploughing work progresses.

"The manager, Mr. Ducret, states it would be just as easy to work a three or four furrow plough as this double, but the holdings being small in this country it is not necessary.

"Mr. Felix, who is here superintending his invention, has a large sugar factory at Sermaize, and there may be seen his various machines worked by electricity, as we indeed see in this showyard.

"The officials connected with the show and many others were present, and the greatest interest was manifested in the trials. Electricity as a motive power is only in its infancy, but who can help feeling sanguine as to its future?

"J. S. COCKSEDGE, of Stowmarket.

"Bar-le-Duc, France, May 22."

THE JAMIN ELECTRIC LIGHT.

ON Friday, June 4th, some trials of the Jamin Electric Light were made in the laboratory of the Compagnie Générale d'Eclairage Electrique, 57, Avenue du Maine. A large concourse of scientific notabilities was present, including M. Gambetta, M. Durrieu, the Minister of Public Instruction, Messieurs Dumas, Perpetual Secretary of the Academy of Sciences; Vaucorbeil, Bréguet, Renier, Hervé-Mangou, Director of the Conservatoire des Arts et Métiers; Antonin Proust; Admiral Moucher, Director of the Observatory; Desain, Professor of Physic at the Sorbonne; Frémy, Director of the Museum; Daubrée, Director of the School of Mines; Hébrard, senator, Director of the *Temps*; Gailly, senator; Delpech, Martial Bernard, Vauthier, Engelhard, Cernesson, of the Municipal Council, &c., &c.

The Halle Electrique, where the experiments were held, is one hundred feet long and seventy feet wide. At the entrance six large opal globes were placed, and on the right and left a row of the Jamin lamps. The Gramme machines were placed at the further end of the room.

After a brief description of his new lamp, M. Jamin performed a series of experiments which showed the capabilities of the apparatus.

By an automatic arrangement the lighting and relighting of the lamps are instantaneous. This result is obtained, without touching the apparatus, by simply establishing or re-establishing the communication.

Should one of the lamps become accidentally extinguished the other lamps continue to burn as usual, and the intensity of their lights is by no means affected by it. Moreover, should one of the candles become consumed, another is instantly and automatically brought into play.

The light may be graduated or regulated at will, from its full power down to the light of a night light.

The light is well divided and can be conveyed at a distance nearly indefinite; for, in the experiments, it has been conveyed to a distance of two miles and a half by a copper wire one millimetre in diameter, and to a distance of ten miles with a wire two millimetres in diameter.

The fixity of the luminous rays was very great, and they were entirely free from violet or red tints.

The *soirée* was wound up by the general illumination of the hall, which was obtained, it is stated, by twenty *indicated* horse-power and forty lights, the illuminating power of which was equivalent to 2,000 Carcel lamps.

The company formed to work M. Jamin's system has a capital of £320,000, all of which has been subscribed. The new company will be possessed of the largest capital which has until now been engaged in the working of electric lighting business, and it can besides reckon on the active concurrence of the Crédit Industriel, one of the largest, oldest, and most favourably known banking establishments of France, and under the patronage of which the new company has been formed.

A very remarkable feature of the new company is, that instead of having been formed as it has up to now been the case, in opposition to the gas companies, and with a view of causing a depreciation of their stock, it has on the contrary been formed with the sympathetic concurrence of personages well known in connection with the industry of gas.

One of its founders, Mr. Gabriel Dehaynin, is one of the most influential, best known, and most largely interested persons in gas property in France. He is the proprietor of more than 60 gas works, and the inventor of a very remarkable process for the manufacture of gas.

THERE is no truth in the statement that the Post Office has come to an agreement with the telephone companies. The suit, it is expected, will shortly be tried.

Notes.

ELECTRICITY ON BOARD SHIP.—A steamer named the *Columbia*, which has just been completed at Chester, Pennsylvania, for the Oregon Railway and Navigation Company, has several novel and interesting appointments. Thus, the Edison electric light is adopted throughout the ship. We learn from the *Scientific American* that the lamps are 120 in number. The lights of the state-rooms are under control of the steward on the out-side. The state rooms on the upper and lower decks are on separate circuits, and so are the saloons. The lamp-fixtures are of the same form as those used for oil lamps, and by an ingenious contrivance they are adapted to either the electric or oil lamp, so that should the former fail in any way, the latter may be at once substituted. The electric lamp globes are frosted lightly by dipping in hydrofluoric acid. The desirability of electric lighting on shipboard, where the apartments are necessarily small, is obvious. The *Columbia* has further an electric head light, consisting of a Maxim electric light. All the rooms are fitted up with electric calls, and the offices, smoking-room, &c., are provided with telephones, the smoking-room being in connection with the steward's room, and the captain's with the chief engineer's, purser's and steward. An electric tell-tale on the bridge enables the captain to tell, by simply pressing a button, whether the engine is going ahead or back, and at what speed. The steering gear has connection with the freight-hoister, but with self-acting attachment. The elevators for discharging cargo are new in design, and the running engines at the ports are arranged so that a loaded truck runs from the lower hold out to the dock entirely by steam. The arrangement of berths is similar to that in a Pullman palace car, and when the berths are not in use they are folded out of the way. The system of water-supply for fire, &c., is most complete; and a new kind of still is used which is capable of supplying 1,200 gallons of pure fresh water daily. The *Columbia* is 334ft. length, 38½ft. beam, 23ft. depth of hold, and 3,200 tons measurement.

THE printing offices of the *Neue Freie Presse* at Vienna are now lighted with Siemens' divided electric lamps.

CURIOUS MAGNETIC EXIERIMENT IN MAGNETISM.—M. Obalski has described a curious magnetic experiment to the French Academy. Two magnetic needles are suspended over water in a vessel by fine threads attached to unlike poles. Their poles are opposite, and are distant from each other by an amount a little greater than the sum of their radii of mutual attraction. The water is gradually brought up over them by means of the tube of caoutchouc connected with the vessel and wound on a drum. When immersion commences, the needles approach each other by their immersed parts, and when the immersion has reached the third or fourth of the needles' length, they touch together. The explanation seems to be, that what hindered the approximation of the needles was their own weight; and the force of gravity being weakened by the immersion, the magnetic forces become manifest. If the needles are suspended by their poles of the same name, a corresponding though opposite phenomenon is witnessed.

PROFESSOR COHN finds that bacteria in a nutritive mineral solution subjected to strong electric currents, become sterilised. Five elements were sufficient in twenty-four hours to effect the result; the action was strongest at the positive pole.

A SUIT has been brought in the Circuit Court at Madison, Wisconsin, America, to collect from an insurance company for damages done by the great storm of 1878. The property was insured against lightning, and the company resist payment on the ground that it was destroyed by wind. The plaintiff hopes to prove by the evidence of members of the Signal Corps that the whirlwind which destroyed his house was of electrical origin. A vast amount of insurance is likely to be affected by the decision of this case, owing to the heavy losses of property during the recent whirlwinds.

General evidence of the electrical character of all tornadoes is found by Prof. Tice in the circumstance that, as a rule, they follow railroads and water courses, and either begin or expend their greatest energy upon them.

THE telephone is now in use for reporting between the House of Commons and the *Times* office. The compositor announces by the bell that he is ready, receives a sentence, strikes the bell to indicate that he understands it, sets up the type with his machine, strikes the bell again for the reader to continue his dictation, and so on until the work is carried as far as time will allow.

IMPROVEMENT IN TELEGRAPH KEYS.—A patent has been issued to Mr. Walter P. Phillips, manager of the New York Associated Press Bureau, at Washington, and of the telegraph line leased by the Associated Press between New York and Washington, for an improvement in telegraph keys. This improvement consists in substituting hardened steel for platinum for the contact points, making the lower contact point large and flat. These lower contact points, or "anvils," fit into a socket, and can be changed whenever necessary, the idea being to supply them by the box, for renewal, when necessary, at a very small price, say two or three cents each. The key is much simplified and its cost greatly reduced. It is stated that the keys have been in constant use for two or three months on the Associated Press wires, and have been tested at the United States signal office and elsewhere, and have given general satisfaction. One of the principal advantages claimed for these keys is that it is impossible to make them "stick."—*Journal of the Telegraph.*

NEW INSTANCES OF MAGNETIC ATTRACTION.—By M. Ader, in *Comptes Rendus*, 1880, p. 864. When making his researches on magnetic quality of wood, paper, and other light bodies, the author made pith balls 5 mm. in diameter, and found that the permanent magnet of Jamin (which supports 100 kilos.), with two small armatures, having a space between of 2 mm., attracted the suspended pith from a distance of 3 or 4 mm. And when once the ball had adhered to it, only rough shaking of the magnet was sufficient to release the ball from its position. The magnet alone sufficed to attract the pith, but in all experiments attraction was much stronger when to the poles of the magnet were added the said soft iron armatures, in close proximity to one another.

M. D. LACHINOFF has constructed a regulator for use with dynamo machines. Any variation of strength of the current in the circuit opens more or less the steam valve of the engine, thus increasing or reducing the speed of the steam engine, and consequently of the dynamo machine.

THE WESTERN UNION TELEGRAPH COMPANY has secured the services of Mr. George d'Infreville, the well-known telegraph engineer.

A BILL to establish a Government postal telegraph service has been introduced in the House of Representatives, America. It directs the Postmaster-General, for the purpose of testing the policy and practicability of maintaining a general system of a postal telegraph line, and of affording to the people of the United States the benefit of a cheap telegraphic communication, to establish by purchase or construction a telegraph line or lines between the cities of Boston and Washington by way of Springfield, Hartford, New Haven, New York, Jersey City, New Brunswick, Philadelphia, Chester, Wilmington, and Baltimore. It provides further that the rates for transmission of telegraphic messages shall be as follows:—For 25 words or less, for a distance of 200 miles or less, 15 cents, with ½ cent for each additional word. For a distance of 500 miles or less, 25 cents, with one cent for each additional word. For 1,000 miles or less, 40 cents, with 2 cents for each additional word. For 2,000 miles or less, 75 cents, with 3 cents for each additional word. For 3,000 miles or less, 1 dol., with 5 cents for each additional word. For less than 200 words, when the messages pass between two adjoining offices, 10 cents for each message, with ½ cent for each additional word. The Postmaster-General is also authorised, without further legislation, to extend the postal telegraph lines between New York, St. Louis, Chicago, and New Orleans, and such other cities and postal stations as he may see fit, provided that the system herein established shall be found to be advantageous and beneficial, and an appropriation of 300,000 dols. is made for the purpose of enabling him to carry out the provisions of this act.

MR. HALL recently in the *Philosophical Magazine* (No. 9, 1880, p. 225), detailed the following experiment:—A very fine leaf of gold, 2 centimetres by 9 centimetres, attached face to face on a glass plate, was placed between the poles of an electro-magnet, the gold leaf being introduced in an electrical circuit, two electrodes from a very sensitive Thomson mirror galvanometer touching the leaf in two places of equal potential, so that the spot remained at zero. If then a strong current was passed through the electro-magnet, immediately the galvanometer showed a difference of distribution of potentials in the leaf.

TELEGRAPH WIRES IN THE CITY.—The countless number of wires that run through the streets on poles and over the top of almost every building in the lower part of the city, is the subject of general and constant attraction from passers-by, and any one with an inquiring turn of mind naturally asks: "I wonder how many miles of wire there are in New York City?" This question has always been an unanswerable conundrum until recently, when inquiry was made at the principal offices of the different companies for the purpose of ascertaining the exact number of miles of wire owned by each, with the following result:—Western Union, 1,109 miles; Gold and Stock, 1,380 miles; Bell Telephone, 800; American District, 450; Atlantic and Pacific, 310; American Union, 250; Law Telegraph Co., 110; Police and Fire Alarm, 100; American Rapid, 88, and Department of Charities and Correction, 20, making a total of 5,567 miles. Besides this number, which represents the number of miles of wire in actual use, there are about 500 miles of "Wild-cat" lines, which are lines put up surreptitiously on the poles of the different companies, and old wires that are no longer used but still remains on the poles. Thus the actual number of miles of wire, in round numbers, is 6,000 miles—enough, if stretched in a single line, to run from New York to the Mediterranean and back. The number of miles of poles owned by the different companies was also ascertained. The Western Union has 53 miles (also used by the Gold and Stock Company), the American Union about 50 miles, and the Fire Alarm 10. The Telephone and the American District Companies generally run their wires over the tops of houses. It is evident to the most casual observer that telegraph wires in this city must eventually be laid underground. With this end in view the Western Union Company have been conducting experiments for some time past. Sixty wires have for some time been laid underground from the Western Union building to to the Courtland Street Ferry, where they connect with the Hudson River cables, and twenty-eight more have recently been laid to 14, Broad Street, which is the most important branch office of the Western Union Company. All of these wires work as well as the aerial lines, and have given much satisfaction; and as the above-named experiments have yielded very satisfactory results, there is no doubt that all of the Western Union wires in this city will be laid underground in the near future. It is only a question of a little time now. When the unsightly poles are removed from the streets and the wires taken off of house-tops, New York will have good cause to rejoice.—*The Magnet.*

THE statement that the Government has purchased Brush lighting apparatus to the extent of several thousand pounds, is untrue. One machine and sixteen lamps have been ordered for trial.

PROFESSOR FLEEMING JENKIN has been awarded the Keith prize by the Royal Society of Edinburgh, for his paper on "The application of graphic methods to the determination of the efficiency of machinery."

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—I enclose herewith the last three tests of the subterranean cable laid by me last September at Bruges, taken by M. Dumont, the engineer of the Belgian Administration. It will be observed that M. Dumont makes the electro-static capacity about one-tenth that made by Mr. Aylmer of the Versailles cable. The two cables are similar, each having 22 conductors. Mr. Aylmer, when he tested one conductor for electro-static capacity, had the 21 other conductors connected to earth, whilst when M. Dumont made his tests all the other conductors of the group were disconnected from earth.

Very truly yours,

Brussels, May 30, 1880. D. BROOKS.

Insulation Tests of Brooks' Cable.

TEMPERATURE.	DATE OF TEST.	RESISTANCE PER KILOMETRE. MEGOHMS.
10° C. ...	April 28th, 1880 ...	904.5
24° C. ...	May 14th, „ ...	290
14° & 17° C.	May 25th, „ ...	276

Electro-static capacity of the Cable.

TEMPERATURE.	DATE OF TEST.	CAPACITY PER KILOMETRE. MICROFARADS.
10° C. ...	April 28th, 1880 ...	0,013
24° C. ...	May 14th, „ ...	0,011
14° & 17° ...	May 25th, „ ...	0,015

These tests were made on the cable laid at Bruges.

J. DUMONT,

Brussels, May 29th, 1880. Engineer.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

(Continued from page 199.)

In 1879 the mileage of Post Office wires used for commercial traffic, existing on railways was 54,067 miles.
Existing on roads and canals . . . 46,784 ,,
Existing in the local submarine cables . 1,805 ,,

102,656

In 1869 the number of instruments fixed upon commercial wires, and used to work them, was as nearly as can be ascertained about 2,200.

In 1879 the number was, of various kinds, 8,151.

It must also be stated that the increase in the rapidity of the instruments employed, *i.e.*, their average power of transmitting messages, is far greater than that of their numbers.

In 1869 there were, for example, two Wheatstone automatic circuits existing in Great Britain — one London to Manchester, one London to Glasgow — worked of course by four instruments.

In 1879 there were 173 such instruments employed.

In 1869 no duplex instruments existed.

In 1879 there were 392 employed.

This means, in effect, that wires formerly worked by ordinary instruments had been practically doubled in numbers by the adoption of the duplex system.

In 1869 quadruplex of course had not been thought of.

In 1879 there were six circuits worked by that invention, making the six wires equal to twenty-four in carrying capacity.

In 1869 no sounder instruments were employed.

In 1879 there were 1,374 of these instruments in use, the result being that an equal number of Morse printers were dispensed with.

It has often been stated that the Government monopoly of commercial telegraphs has stifled invention. Such statements are wholly without foundation. No invention promising either superior results to those previously attained, or promising to effect equal results with greater economy, or other distinct advantages, will ever be otherwise than welcome to the Department.

Where an alteration would have the effect of throwing out of use a large stock of apparatus, in which a very large capital had been embarked, it is clear that such alteration must be of very decided advantage; a trifling gain over existing means would not be sufficient to justify the commercial waste, so to speak, that must arise from its adoption. But if there is a great advantage, even this loss would be submitted to, rather than that the invention should be ignored. No doubt, in one respect, inventors do not find the market quite so open to them as formerly. When it was possible for several commercial companies to struggle against each other, it was always possible for the inventor of a novelty (although such novelty might be in no essential particular really superior to what was previously existing) to get the assistance of a promoter to form a company to work it. Thus, when the Electric Telegraph Company were depending chiefly on Cooke and Wheatstone's needle instrument, one of their first rivals was started to work Henley's magnetic needle telegraph, although most certainly, so far as the public were concerned, the working of this apparatus gave them no advantage, whatever the creation of an opponent company might do. In fact, not long after, the company owning it employed other instruments.

In this respect, do doubt, the Monopoly Act has closed one field of speculation; but the Post Office cannot be blamed for an unavoidable effect, and perhaps not altogether an undesirable one.

But wherever good has been found it has been availed of. The inventive genius of our Transatlantic cousins has had a fair field of action in our borders, and its worth has been fully and practically acknowledged.

As an illustration of the steady, though not show progress that the Post Office has made in the improvement of its apparatus—a degree of improvement really far more valuable than the introduction of ordinary inventions—it may be stated that, when Sir Charles Wheatstone brought his automatic instrument to the Electric Telegraph Company in 1866, it was only possible to work it at the rate of about 55 to 60 words a minute if a wire of No. 8 gauge was employed, increasing to 80 words a minute if a wire of No. 4 gauge were used; this over a circuit about 280 miles in length.

In 1879 it was possible to work for distances of 300 miles with No. 8 gauge wire at over 200 words a minute, and regularly and in all weathers at 130 words, and this with 70 miles of cable in circuit.

These improvements have been brought about almost wholly by the officers of the Department and of the former telegraph company, and by the skill of the mechanics acting with them.

In 1869 the length of internal submarine cables was about 121 knots, the total being made up of 18 separate cables.

In 1879 this total had grown to 614 knots, including 58 separate cables, containing from one to seven conducting wires respectively.

Three miles of pneumatic tubes were in use in 1869.

In 1879 there were in existence over 27 miles.

In 1869 the number of towns supplied with intelligence by electric telegraph in this country was 144, and in them news was furnished to 173 newspapers and 133 other subscribers.

In 1879 the number had increased to 313 towns, 518 newspapers, and 288 institutions or individuals supplied.

And the number of words transmitted—which in the days of the telegraph companies was a varying daily average of from 4,000 in the non-parliamentary season to 6,000 when the Houses were sitting—has grown until, in 1879, it reached 24,000 and 37,000 words in the corresponding seasons. This news is despatched by the two great Press agencies to the towns enumerated previously, the actual words transmitted over the wires to the various places often exceeding half-a-million, the same words having to be repeated to many places.

Besides this, from 30,000 to 70,000 words per diem, according to the season, are despatched as special reports for various London and provincial newspapers, from their own correspondents, being wholly additional to the general news supply.

There are certain newspapers to whose use special wires are devoted, *i.e.*, instead of receiving intelligence transmitted over the ordinary wires in the ordinary way, they have arranged to have certain wires given up for their sole use from 6.0 p.m. to 6.0. a.m., or other hour, and send over them whatever matter they like without its being counted as business done by the Post Office, clerks being lent to them for the purpose.

The Electric Telegraph Company, prior to the transfer, had inaugurated this system.

In 1869 there were a total of 6 special renters, each paying from £750 to £1,000 per annum for the wire appropriated to them. In 1879 there were 24 such renters, each paying £500.

The private telegraphs amounted to 2,525 miles of wire, worked by 1,466 instruments, in 1869.

On the 31st December, 1879, the Post Office maintained for the use of private persons 6,550 miles of wire and 3,824 instruments, or, including wires used by railways in Ireland for their own purposes, and by certain canal companies, which are maintained also by the Post Office staff, the total is 9,269 miles of wires and 4,607 instruments.

The Post Office possesses no monopoly of private wires, and in calculating the whole existing telegraphs of the country, a large addition must be made to represent the wires and instruments fixed in various localities by private contractors, not forgetting the recent active operations of the various telephone companies.

So far as it can be ascertained, the gross earnings of all English telegraphs in 1869 may be stated with certainty as not more than £700,000.

In 1879 the earnings of the Post Office Telegraphs were on the whole £1,436,000—a sum more than double the amount of the largest earnings of the telegraph companies. Moreover, ten years after the transfer of the lines to the State had been effected, the balance-sheet of the Department shows that the telegraphs have become practically remunerative, *i.e.*, that for the financial year ending 31st March, 1880, there is for the first time almost an equilibrium between receipts and expenditure, including in expenditure the full interest on the capital borrowed for the purpose of purchasing and extending the telegraph undertakings, and the total capital cost of all extensions during the year for which the receipts are stated; from which latter are excluded the value of services performed for other Government Departments, and value of materials, &c., sold, amounting on the whole to £36,000. To be exact, in the year 1878-79 the sum required from the national coffers to make up the actual interest on capital was over £114,000; for the year 1879-80 the precise calculations are not made; but although the amount of capital on which interest has to be paid is increased by a sum absorbing over £4,000 per annum, the deficiency will pretty certainly be not above £30,000. It is probable that, if the accounts were compiled on the system that would be adopted by a commercial company, this deficiency would be converted into a surplus of an equivalent sum.

In 1869 the working of the various telegraph undertakings, other than those of railway companies, employed a total force of 2,514 clerks, 479 of whom were females, and 1,471 messengers.

In 1879 the clerks numbered 5,611, of whom 1,556 were females, and 4,648 messengers.

For the financial year ending 31st March, 1873, the number of telegrams forwarded throughout the United Kingdom was 15,535,000; it was for the year ending 31st March, 1880, over 26,500,000, being an addition of nearly three-fourths in seven years.

The first year taken for this comparison is the one named (1873) because otherwise due allowance would not be made for the immediate expansion of business which arose after January, 1870, in consequence of the large increase in the number of offices, and of the operation of the uniform shilling rate.

In 1878 the population of Great Britain and Ireland was reckoned at 33,799,000, and this population exchanged a total of 24,600,000 messages.

In France the population of 36,900,000, employed the telegraph to the number of 14,400,000 messages, or upwards of 10,000,000 less than the number passed over the wires of this country.

In Germany, with a population of 42,700,000, the number of telegraphic despatches was barely 100,000 more than those of France, or 14,540,000.

The only cases in which the proportionate number of messages is at all larger than in Great Britain are those of Belgium and Switzerland.

In neither of these States does the total number of messages amount to 1 per head of the population, and in Belgium the number forwarded is even closer to the British ratio as compared with population. But both these countries derive an exceptional advantage from the number of foreign telegrams passing through them, and not, as it were, resting within their borders. English messages are not swollen to any appreciable extent from this cause. Switzerland, moreover, has its native business largely increased by the host of locomotive and telegraphing foreigners annually attracted to the playground of Europe. Hence it may be fairly said that England is decidedly ahead of continental Europe in the matter of telegraphic employment.

During the present year arrangements have been made for the erection of over 5,000 miles of new wire, intended to meet the demands upon the system made by the prospect of reviving trade. The cost will not add to capital sunk in telegraphs, but will be all charged to the revenue of the Department.

For two or three years past, owing to the commercial stagnation that has prevailed, the rate at which the use of the telegraph has progressed has been but slight.

As regards railway telegraphs there are at present 14,889 miles of poles, 62,099 miles of wires, 13,128 speaking instruments, 22,411 block instruments, and 11,308 semaphore repeaters. All these being used for working the "block" system.

In the discussion which followed the reading of the paper

SIR CHARLES BRIGHT, late chief engineer to the British and Irish Magnetic Telegraph Company, said that he considered that the progress that had been made in telegraphy under Government management was highly creditable. As regards Sounders, he pointed out that his Bell system was entirely one of sound, and was exclusively used by the company of which he was engineer. He hoped that at some future date statistics of foreign messages would be forthcoming.

MAJOR WEBBER pointed out that Mr. Graves' paper was the first of the kind that had been read before the Society; the period chosen was particularly a happy one, inasmuch as it was coincident with the growth of the Society of Telegraph Engineers. He expressed a hope that a 6d. rate for telegrams would shortly be introduced.

Mr. C. E. SPAGNOLETTI, in seconding a vote of thanks, complimented Mr. Graves on the paper he had read, which must have involved a great deal of trouble to get up.

Mr. ROBERT GRAY said that as regards the cheapening of telegrams, the traffic on the Marseilles-Algiers cable, which was formerly transmitted at the rate of 2d. per word, could now be sent for 1d. per word, two cables being used for the purpose. The increase in traffic consequent on the reduced rate had quite paid for the new cable.

The PRESIDENT having made some concluding remarks, the meeting adjourned.

AT an extraordinary general meeting of the Society held June 3rd, Mr. W. H. PREECE, President, in the

chair, the minutes of the last general meeting having been read and confirmed, Dr. C. WILLIAM SIEMENS, D.C.L., LL.D., F.R.S., Past President of the Society, read a paper on "The Dynamo-Electric Current in its application to Metallurgy, to Horticulture, and to the Transmission of Power."

Amongst the means at our disposal for effecting the fusion of highly refractory metals, and other substances, none has been more fully recognised than the hydro-oxygen blast. The ingenious modification of the same by M. H. Ste. Claire de Ville, known as the Deville furnace, has been developed and applied for the fusion of platinum in considerable quantities by Mr. George Matthey, F.R.S.

The Regenerative Gas Furnace furnishes, however, another means of attaining extremely high degrees of heat, and this furnace is now largely used in the arts—among other purposes, for the production of mild steel. By the application of the open hearth process, 10 to 15 tons of malleable iron, containing only traces of carbon or other substances alloyed with it, may be seen in a perfectly fluid condition upon the open hearth of the furnace, at a temperature probably not inferior to the melting point of platinum. It may here be remarked that the only building material capable of resisting such heats is a brick composed of 98·5 per cent. of silica, and only 1·5 per cent. of alumina, iron, and lime, to bind the silica together.

In the Deville furnace extreme degrees of heat are obtained by the union of pure oxygen with a rich gaseous fuel under the influence of a blast, whereas in the Siemens' furnace it is due to slow combustion of a poor gas, potentiated, so to speak, by a process of accumulation through heat stores or regenerators.

The degree of heat attainable in both furnaces is limited by the point of complete dissociation of carbonic acid and aqueous vapour, which, according to Ste. Claire de Ville and Bunsen, may be estimated at from 2,500° to 2,800° C. But long before this extreme point has been reached, combustion becomes so sluggish that the losses of heat by radiation balance the production by combustion, and thus prevent further increase of temperature.

It is to the electric arc, therefore, that we must look for the attainment of a temperature exceeding the point of dissociation of products of combustion, a temperature not much inferior to that of the sun.

The object of the paper is to show that the electric arc is not only capable of producing very intense degrees of heat in a focus or extremely contracted space, but also such larger effects of intense heat, with moderate expenditure of energy, as will render it useful in the arts for effecting the fusion of platinum, iridium, steel, or iron, or for such reactions or decompositions as require for their accomplishment an intense degree of heat, coupled with freedom from disturbing influences such as are inseparable from a furnace worked by the combustion of carbonaceous material.

The apparatus employed to effect the electro-fusion of such material as iron or platinum consists of an ordinary crucible of plumbago or other highly refractory material, which is placed in a metallic jacket or outer casing, the intervening space being filled up with pounded charcoal or other bad conductor of heat. A hole is pierced through the bottom of the crucible for the admission of a rod of iron, platinum, or dense carbon, such as is used in electric illumination. The cover of the crucible is also pierced for the reception of the negative electrode, by preference a cylinder of compressed carbon of comparatively large dimensions. At the end of a beam supported at its centre is suspended the negative electrode by means of a strip of copper, or other good conductor of electricity, the other end of the beam being attached to a hollow cylinder of iron free to move vertically within a solenoid coil of wire, presenting a total resistance of about 50 units or ohms. By means of a sliding weight the preponderance of weight of the beam in the direction of the solenoid can be varied so as to balance the magnetic force with which the hollow iron cylinder is drawn into the coil. One end of the solenoid coil is connected with the positive, and the other with the negative pole of the electric arc, and, being a coil of high resistance, its attractive force on the iron cylinder is proportional to the electro-motive force between the two electrodes, or, in other words, to the electrical resistance of the arc itself.

The resistance of the arc was determined and fixed at will within the limits of the source of power, by sliding the weight upon the beam. If the resistance of the arc should increase from any cause, the current passing through the solenoid would gain in strength, and the magnetic force overcoming the counteracting weight would cause the negative electrode to descend deeper into the crucible; whereas, if the resistance of the arc should fall below the desired limit, the weight would drive back the iron cylinder within the coils, and the length of the arc would increase, until the balance between the forces engaged had been re-established.

In working with the modified medium-sized dynamo machine, capable of producing 36 webers of current with an expenditure of 4 horse-power, and which, if used for illuminating purposes, produces a light equal to 6,000 candles, it is found that a crucible of about 20 centimetres in depth, immersed in a non-conductive material, is raised up to a white heat in less than a quarter of an hour, and the fusion of 1 kilogram of steel is effected within, say, another quarter of an hour, successive fusions being effected in somewhat diminishing intervals of time. It is quite feasible to carry on this process upon a still larger scale by increasing the power of the dynamo-electric machine and the size of the crucibles.

The dynamo-electric machine consuming 4·25 horse-power, or 3·17 ergtens, per second, will send a current of 40·5 webers through 1 unit electrical resistance; replacing the resistance by an arc maintained by the balance-weight constantly at 37·8 volts electro-motive force, the same current will flow.

Neglecting the connecting wires, there will be developed in the arc an energy of

$$1{,}531{\cdot}2 \times 10^7 \text{ ergs. per second} =$$
$$9{,}187{\cdot}2 \times 10^8 \text{ ergs. per minute} =$$
$$1{,}378{\cdot}1 \times 10^{10} \text{ ergs. per 15 minutes} =$$
$$32{\cdot}8 + 10^4 \text{ gram water degree units of heat.}$$

Assuming steel to have the same specific heat as iron, viz., at $t^0 =$

$$\cdot 1040 \times 0{\cdot}000144\, t,$$

and that the melting point of steel is 1,800° C., then 420·5 units of heat will be expended in raising the steel to this temperature; and assuming the latent heat of fusion at 29·5 units (silver is 21, and zinc 28), there are roughly 450 units required to melt a gram of steel, and 225,000 to melt half a kilogram, that is about $\frac{3}{4}$ of the heat generated in the crucible, and $\frac{1}{3}$ of the horse-power actually expended. A good expansive condensing steam engine converts the heat energy residing in coal into mechanical energy, with a loss of about 80 per cent., or, in other words, $\frac{1}{5}$ only of the 7,000 units residing in a gram of ordinary coal is represented as work in the engine. The useful effect attainable in the electric furnace is therefore $\frac{1}{4} \times \frac{1}{3} = \frac{1}{15}$ of the heat energy residing in the fuel consumed under the boiler of the engine.

(*To be continued.*)

New Patents—1880.

2147. "Electric light apparatus." W. L. WISE. (Communicated by J. A. Mandon.) Dated May 26.

2183. "Railway signalling apparatus." C. E. SPAGNOLETTI. Dated May 28.

2207. "Conductors of lightning." O. WOLFF. Communicated by W. Michalk.) Dated May 31.

2208. "An improved fire and burglar alarm." J. McNeill. Dated May 31.

2229. "Improvements in the construction of apparatus for lighting gas, part of which apparatus is also applicable to other electrical appliances." C. L. CLARKE and J. LEIGH. Dated June 1.

2235. "New or improved modes and means or apparatus for signalling or communicating between passengers and servants in railway trains." E. GILBERT and A. E. GILBERT. Dated June 1.

2236. "A new or improved electric lamp with automatic regulation for the purpose of lighting by electricity, and effecting a regular uniform approach of the two electrodes or candles in the proportion as they are consumed." S. COHNÉ. Dated June 1.

2252. "Electric lamps." G. G. ANDRÉ and E. EASTON. Dated June 2.

2272. "Obtaining, increasing, and employing currents of electricity." T. SLATER. Dated June 3.

2305. "Improvements in apparatus for securing the proper relative working of switches, crossings, and signals, and the more certain and effective working of the signalling devices on railways." J. S. WILLIAMS. Dated June 8.

2312. "Improvements in diving bells and in electrical and other apparatus to be employed in connection therewith for submarine or subaqueous operations, parts of which apparatus are applicable for other purposes." W. R. LAKE. (Communicated by C. F. Pike.) Complete. Dated June 8.

2354. "Improvements in and connected with batteries, whereby they are converted into transmitters of sound." R. H. COURTENAY. Dated June 10.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

4170. "Interlocking the telegraphic block instrument with the points and signals of railways." C. HODGSON. Dated October 15. 6d. The apparatus employed for the above and which is intended to give greater security to the traffic of railways, consists of three principal parts; first, a locking handle which can be moved by hand into either of two positions, so as to lock and unlock the point and signal levers; secondly, a commutator with its plunger for making electrical connections, and transmitting telegraphic signals to another station; and thirdly, a detent which is connected to and worked either by one of the ordinary semaphore signals, or by a treadle or trigger acted on by a passing train, the connections for this purpose being either mechanical or electrical.

4298. "Apparatus for transmitting and receiving signals on ships and vessels," &c. FRANK RICARDO FRANCIS. Dated October 22. 8d. Consists in the combination and arrangement of an instrument containing a series of commutators and transmitting keys corresponding to the number of signals required to be employed.

4306. "Automatic contact breakers for electric circuits." THOMAS WILKINS. Dated October 22. 2d. Consists in the use of an air-chamber or vacuum bellows in which a slight leakage is permitted. The said air-chamber or vacuum bellows is connected with the contact surfaces of the electric circuit and the air is expelled from the chamber when the said surfaces are in contact or *vice versa*. In lieu of the air chamber clockwork may be used. *(Provisional only.)*

4346. "Galvanic batteries." R. C. ANDERSON. Dated October 24. 2d. (Relates to batteries described in our last issue.) *(Patent void.)*

4354. "Electric lamps." A. S. HICKLEY. Dated October 25. 6d. Describes lamps similar to those illustrated in this journal.

4400 "Electric apparatus." W. R. LAKE. (A communication from Professors Houston and Thomson.) Dated October 29. 1s. Consists of a dynamo electric machine, the coils of the field magnets being wound conically, the wide portion being placed as near as possible to the revolving armature, and serving thereby, in addition to the ordinary purpose of magnetising the field magnets, to directly influence and strengthen the polarisation of the said armature. Likewise of a regulator lamp, and also of a storage battery. The claims are twenty-seven in number.

4404. "Electric batteries." A. V. NEWTON. (A communication from F. Tommasi.) Dated October 29. 6d. Belong to that class of battery in which two exciting liquids are used, and each cell is an outer vessel, consisting of two cylinders of about equal depth, but of different diameters, joined together end to end. The lower half of this vessel has a smaller diameter, and constitutes the bottom of the vessel. The annular portion which joins the two cylinders together constitutes an annular gutter, and forms a support for a cylinder of zinc, which is attached by cement to the upper half of the vessel. This zinc cylinder is bevilled at its upper periphery, to form between it and the vessel a gutter for the reception of mercury, and in the gutter at the foot of the zinc cylinder mercury is also placed; this for the purpose of maintaining the amalgamation of the zinc. Within the zinc cylinder, and reaching down to the bottom of the outer vessels, a cylindrical porous pot is placed. This pot is glazed at the bottom, and to about one-half its height, or to a level with the bottom edge of the zinc cylinder, and from its top down to a level with the exciting liquid contained in the outer vessel. In this partially porous pot a semi-cylinder of carbon, about half the depth of the pot, is suspended, and a semi-cylinder of glass or earthenware of corresponding bulk is provided, which is also suspended from a rod sliding through a cover with which the cell is fitted. The outer vessel is filled with dilute sulphuric acid, and the porous pot with strong nitric acid. To set the cell in action it is only necessary to depress the semi-cylinder of earthenware in order to displace the nitric acid at the bottom of the pot, and cause it to rise and surround the carbon.

4405. "Electric lamps." A. V. NEWTON. (A communication from F. Tommasi.) Dated October 29. 6d. In constructing a pedestal lamp a carbon block is used, carried by a central rod for a series of carbon electrodes to butt against. These carbon electrodes float in mercury tubes, which incline inwards towards a common centre.

4428. "Electrical apparatus." E. G. BREWER. (A communication from E. A. Chambrier.) Dated October 30. 6d. Consists of a new arrangement of electro-

magnet, whereby the apparatus can be regulated in such a manner as to find the most favourable point for obtaining the maximum of attractive power or force, by making an electric current pass into the bobbins, and also in the deformation or changing of the form of the ordinary plane surfaces of the armature, and of the end of the bar, so as to increase the dimensions of the surface presented.

4440. "Telephones." J. H. JOHNSON. (A communication from Clement Ader.) Dated October 31. 2d. Relates to the employment in telephones, and especially in the receiving instruments, of a superexciting plate of soft iron, arranged behind the vibrating metallic diaphragm, and at a very short distance from the latter, whereby the sounds emitted are rendered more intense and more distinct than in telephones of the ordinary construction. (*Provisional only.*)

4456. "Apparatus for containing and protecting telegraph wires." J. T. KING. (Communicated by C. Linford.) Dated November 1. 2d. Consists in constructing apparatus for containing and protecting telegraph wires of lengths of metal rolled, cast, or otherwise formed, with grooves or channels for containing the wires. The grooved or channelled surface is enamelled with porcelain or other insulating material; the surface of said containers, which are in contact with earth, being tinned or japanned to prevent rusting. (*Provisional only.*)

City Notes.

Old Broad Street, June 14th, 1880.

THE directors of the Brazilian Submarine Telegraph Company (Limited) have declared an interim dividend of 2s. 6d. per share, or 5 per cent. per annum free of income tax, for the quarter ended March 31 last.

THE office of the Western and Brazilian Telegraph Company is removed to 19, Great Winchester Street.

THE office of the Great Northern Telegraph Company is removed to 119, Bishopsgate Street.

THE "Compagnie Française du Télégraphe de Paris à New York," having commenced business from London to the United States at a 2s. rate, the Anglo Company have reduced their tariff to 6d. per word, whilst the Direct Company retain theirs at 2s. The London receiving office of the new Company is at 24, Royal Exchange.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY (LIMITED).—The third ordinary general meeting was held on the 4th inst. The chairman (Mr. A. R. Johnston) expressed his regret that the final accounts from the stations on the West Coast had not yet been received. They had had a few lines from their general manager at Lima, in which he mentioned that he had forwarded a mail overland which had not then come to hand, but it was not stated whether the accounts had also been sent. They knew that there had been great difficulty in getting the accounts together from the disturbed state of the coast. Very little had happened since their meeting six weeks ago, but he regretted to say that so far as their earnings were concerned matters had not improved in the interval. The war continued to drag along; Mollendo had been entered, and had been more or less destroyed by the Chilian forces, and the Company had thus suffered pretty severely. He did not know that it was anything very great as regarded money, but their property had been destroyed. Part of the instruments, however, had been saved, which would enable them to continue working when they had the opportunity. They were in imminent danger of being driven out of Callao, in which case they would retire on Lima. They were waiting till matters became more settled. As regarded their earnings, he informed them six weeks ago that they were looking better. In January the receipts were an improvement on those of December, and February and March had a further increase, but that seemed to be the turning-point. In April the receipts went back materially, and May was also disappointing, but that was approximate only. After a few remarks by shareholders a discussion ensued on a motion for the appointment as a director of Mr. R. Kendal, and ultimately the motion was carried. The retiring directors and auditors were re-elected, and the proceedings terminated.

THE directors of the Western and Brazilian Telegraph Company have issued an interim report together with a balance sheet for the half-year ending 31st March last. It states that after deducting £3,967, balance of "special cable repairs," carried forward from the last balance sheet, a profit of £15,992 has been earned upon the Company's system during this period. The gross receipts from the 1st of October show an increase as compared with the corresponding period of the preceding half-year of £20,521. The question of competition by the Brazilian Government land lines with the Company's system has had the Board's serious consideration, believing, as they do, that it is opposed to the letter and the spirit of the concession under which the cables are worked. Special representations have been made to the Government, and in view of the strength and justice of the case the Board have strong hopes that the competition, as at present carried on, will not be allowed to continue, and the Government of Brazil fulfil in its integrity its pledges to the Company.

The following are the final quotations of telegraphs:—Anglo-American Limited, 59½-60¼; Do., Preferred, 90-91; Ditto, Deferred, 32¾-33¼; Black Sea, Limited, ——; Brazilian Submarine, Limited, 8⅞-8¼; Cuba, Limited, 9¼-9¾; Cuba, Limited, 10 per cent. Preference, 15¼-16¼; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10¼-11¼; Direct United States Cable, Limited, 1877, 10¾-11; Scrip of Debentures, 100-102; Do., £50 paid, par-2 pm.; Eastern, Limited, 8⅞-9¼; Eastern 6 per cent. Preference, 12¼-12⅝; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-105; Eastern 5 per cent. Debentures, repayable August, 1887, 101-103; Eastern, 5 per cent., repayable Aug., 1899, 103-105; Eastern Extension, Australasian and China, Limited, 9-9¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 103-105; Ditto, registered, repayable 1900, 103-106; German Union Telegraph and Trust, 8¾-9; Globe Telegraph and Trust, Limited, 5¾-6; Globe, 6 per cent. Preference, 11¾-12; Great Northern, 9⅜-9¾; Indo-European, Limited, 22-23; London Platino-Brazilian, Limited, 4¼-5¼; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10¼-11; Reuter's Limited, 9¼-10¼; Submarine, 235-245; Submarine Scrip, 2¼-2¾; West Coast of America, Limited, 1⅜-1⅝; West India and Panama, Limited, 1¼-1½; Ditto, 6 per cent. First Preference, 7⅛-7½; Ditto, ditto, Second Preference, 6¼-7; Western and Brazilian, Limited, 7⅜-7⅝; Ditto, 6 per cent. Debentures "A," 100-103, Ditto; ditto, ditto, "B," 100-103; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 117-122; Ditto, 6 per cent. Sterling Bonds, 103-105; Telegraph Construction and Maintenance, Limited, 33⅜-34; Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus Trust Certificates, 3⅛-3⅜; India Rubber Company, 14¼-14½; Ditto 6 per cent. Debenture, 104-106.